Society of Exploration Geophysicists
*The international society of applied geophysics*

In Continuation of Society's Effort to Promote Geoscientific Education and Training, Society of Petroleum Geophysicists is Organizing
SEG/EAGE Distinguished Instructur Short Course (DISC 2010)
on
**"Geophysics Under Stress: Geomechanical Applications of Seismic and Borehole Acoustics Waves"**
By
Dr. Colin Sayers, Scientific Advisor, Schlumberger Data & Consulting Services, Houston

**Program:**

**Date:** 1st October, 2010

**Time:** 08.30 hrs to 1700 hrs

**Venue:** REGUS MUMBAI, Bandra Kurla Complex
Levels Ground & 1, Trade Centre
Bandra Kurla Complex, Bandra (E)
Mumbai-400 051, India
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The details of registration fee are as follows:

**SEG/EAGE and SPG Members**: US $100 or Rs. 5000

**Non SPG Members**: US $ 112 or Rs. 5500

Those who want to get benefited by the course may please send their requests for registration latest by 27th September, 2010 to SPG, India by fax or email. SEG/EAGE and SPG Members are requested to provide their membership reference.

Fax No: 022-26599808/0135-2752088

Email: saha.apurba@gmail.com
sbag1962@yahoo.co.in
spgindia@rediffmail.com

Details of the course can also be accessed through the following link:
http://www.seg.org/SEGportalWEBproject/portals/SEG_Online.portal?_nfpb=true&_pageLabel=pg_gen_content&Doc_Url=prod/SEG-Education/sayersabstract.htm

## *2010 SEG/EAGE Distinguished Instructor Short Course*
## *Geophysics Under Stress: Geomechanical Applications of Seismic and Borehole Acoustic Waves*
*Colin M. Sayers, Schlumberger*

### *Overview*

The state of stress within the earth has a profound effect on the propagation of seismic and borehole acoustic waves, and this leads to many important applications of elastic waves for solving problems in petroleum geomechanics. The purpose of this course is to provide an overview of the sensitivity of elastic waves in the earth to the in-situ stress, pore pressure, and anisotropy of the rock fabric resulting from the depositional and stress history of the rock, and to introduce some of the applications of this sensitivity. The course will provide the basis for applying geophysics and rock physics solutions to geomechanical challenges in exploration, drilling and production. A variety of applications and real data examples will be presented, and particular emphasis will be placed on the rock physics basis underlying the use of geophysical data for solving geomechanical problems.

### Summary

The following topics will be addressed in the course:

• **Introduction to the effects of stress in the earth.** Why pore pressure, in-situ stress and geomechanical properties are important.

• **Sediment compaction and the state of stress in the earth.** Vertical stress, pore pressure and sediment compaction. Horizontal stress in a relaxed basin. Estimation of the minimum and the maximum horizontal stress. Tectonic strains.

• **Pore pressure.** Velocity vs. effective stress relations. Pore pressure estimation from velocity. Clay diagenesis. Unloading. The need for fit-for-purpose seismic velocities. Uncertainty analysis. Combining seismic velocities with well velocities for improved pore pressure estimation. Dipping layers and lateral pore pressure transfer.

• **Stress sensitivity of sandstones.** Third-order elasticity theory. Dependence of elastic wave velocities on porosity in sandstones. The importance of compliant grain boundaries,

microcracks and fractures on velocities in sandstones. The use of elastic waves to monitor stress-induced damage.

• **Wellbore stability and wave velocities near a borehole.** Stress changes in the vicinity of a borehole. Mechanical behavior of rock in the vicinity of a borehole. Stress dependence of elastic wave velocities. Linearized expressions for the change in velocity for small changes in stress.

• **Reservoir geomechanics and 4D seismic monitoring.** Reservoir stress path. The effect of stress path on rock deformation and failure. Rock failure. Monitoring reservoir stress changes using time-lapse seismic. The difference in reservoir stress path between injection and depletion.

• **Fractured reservoirs.** Effects of fractures on seismic waves. Multiple fracture sets. Amplitude Versus Offset and Azimuth (AVOA). Simplifications for weak anisotropy. Effects of inequality between the normal and shear compliance of fractures. Microstructural models of fracture compliance.

• **The seismic anisotropy of shales.** The relation of shale anisotropy to microstructure. The effect of interparticle regions on seismic anisotropy. Clay mineral anisotropy. Effect of disorder in the orientation of clay particles. The static elastic moduli for a TI medium and the implications for hydraulic fracture containment.

## Who should attend?

The integrated nature of this course means that it is suitable for individuals from all subsurface disciplines including geophysics, geomechanics, rock physics, petrophysics, geology, geomodeling, and drilling, reservoir and petroleum engineering. The short-course presentation, limited to one-day, will provide an overview of the basic concepts and applications, and minimizes the use of mathematical developments.

As a result, the course presentation does not require a theoretical background and can be attended by a broad section of working geoscientists and engineers interested in applying geophysical data to the solution of geomechanical problems. The course book will provide support for the course, and further extend some of the more technical considerations.

## Biography

Colin Sayers is a Scientific Advisor in the Schlumberger Data & Consulting Services Geomechanics Group in Houston, providing consultancy in geophysics, rock physics, drilling and reservoir geomechanics and the characterization of fractured reservoirs. He entered the oil industry to join Shell's Exploration and Production Laboratory in Rijswijk, The Netherlands in 1986, and moved to Schlumberger in 1991.

His technical interests include geophysics, rock physics, drilling and reservoir geomechanics, pore pressure prediction, wellbore stability analysis, analysis of production-induced reservoir stress changes, subsidence, fault reactivation, 3D mechanical earth modeling, sanding, fractured reservoir evaluation, borehole/seismic integration, stress-dependent acoustics, advanced sonic logging, AVAZ, fluid flow in fractured reservoirs.

He is a member of the AGU, EAGE, SEG, and SPE, a member of the Research Committee of the SEG, and a member of the editorial board of The Leading Edge and the International Journal of Rock Mechanics and Mining Science. He has a B.A. in Physics from the University of Lancaster, U.K., a D.I.C. in Mathematical Physics and a Ph.D. in Physics from Imperial College, London, U.K. He has published numerous papers and holds several patents in the areas covered by this course.